
RESEARCH ARTICLE

Study on genotypic differences for high molecular weight subunits of Indian bread wheat (*Triticum aestivum* L.)

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Abstract

Bread making quality characterization of wheat genotypes is a widely used approach to evaluate breeding material. High Molecular Weight (HMW) glutenin subunits of 27 Indian wheat varieties were determined using SDS-PAGE. A Glu-1 quality was calculated for each variety based on previously observed associations between individual HMW subunits and SDS-sedimentation volume. The results indicated that genotypes WH 423, WH 533, WH 542, PBW 343, UP 2425 and HGPC have highest Glu-1 quality score. These varieties are known to have good bread making quality. HMW glutenin subunits 5+10 controlled by Glu-D1 locus demonstrated the highest effect on bread making quality.

Key words: Wheat, SDS-PAGE, high molecular weight, *Triticum aestivum.*

Introduction

Glutenins and Gliadins are two major groups of seed storage proteins in hexaploid wheat (*Triticum aestivum* L.). Their genetics and biochemistry have been extensively studied and both group have been shown to be important determinants of bread making quality (BMQ) (Payne *et al*., 1980, Poperelya and Blagodarova, 1998, Igrejas *et al*., 1999). Due to their inheritance being well characterized and their high level of polymorphism, they have proved of immense value in breeding and genetical research. The allelic variation in the high molecular weight (HMW) subunits of glutenins are coded by genes at three genetically linked loci, Glu-A1, Glu-B1and Glu-D1, which occur on chromosome 1A, 1B and 1D, respectively (Payne *et al*., 1987, Galova *et al*., 2002). A quality score assigned to individual or pairs of HMW glutenin subunits has made it possible to evaluate the potential of bread making quality (BMQ) of a line or variety on the basis of its glutenin pattern (Glu-1 quality score). Studies carried out on wheat varieties from Europe and India showed that between one-third and one-half of the variation in BMQ could be accounted for by differences in HMW glutenin subunit composition (Payne *et al*., 1988; Rogers *et al*., 1989; Lukow, 1989, Bhagwat and Bhatia 1993). This score was correlated positively with bread making and negatively with biscuit making qualities. Glu-1 quality score can serve as a useful selection criterion in breeding programme (Bhagwat and Bhatia 1993). Wheat varieties are classified for their end-use quality (Chapati, bread and other products) on the basis of dough strength, pelshenke and SDS-Sedimentation values. (Hanslas and Tandon, 1987). Hence, by

considering all above points the present investigation was undertaken to determine the high molecular weight (HMW), glutenin subunits of 27 Indian wheat genotypes by using the SDS-PAGE.

Materials and methods

Twenty-seven genotypes were used in this study (Table 1). SDS-PAGE was carried out by a procedure that was based on the Laemmli method (Laemmli, 1970). The HMW glutenin subunit composition of each variety was determined by using 10% polyacrylamide gels. Quality scores were assigned by the method of Payne *et al*., (1987) in which a score is assigned to each subunit pairs expressed in a genotype. The quality score is set up to range from 1 to 10 with 10 representing highest quality and 1 representing lowest quality.

Table1: High and low molecular weight profiles of Glutenin protein in bread wheat

Sr. No.	Genotype	Glu-A1	Glu- B1	Glu-D1
1	WH 147	N	7+8	2+12
2	WH 157	N	7+9	2+12
3	WH 283	N	7+8	2+12
4	WH 291	N	7+8	2+12
5	WH 416	N	20	2+12
6	WH 423	1	17+18	5+10
7	WH 533	2*	7+9	5+10
8	WH 542	2*	7+9	5+10
9	WH 711	1	7+9	2+12
10	C 306	1	20	5+10
11	C 591	1	20	5+10
12	Sonak	N	7+9	2+12
13	HD 2687	N	7+9	2+12
14	PBW 343	1	7+9	5+10
15	PBW 373	N	7+9	5+10
16	Raj 3765	2*	7+8	2+12
17	UP 2338	2*	17+18	2+12
18	UP 2425	2*	7+9	5+10
19	C306M10	1	17+18	2+12
20	DI 8	1	17+18	2+12
21	DI 9	1	17+18	2+12
22	DI 16	N	20	2+12
23	DI 20	N	20	2+12
24	DI 716	N	7	5+10
25	DI 717	N	7+8	5+10
26	DI 728	N	7+8	5+10
27	HGPC	2*	7+9	5+10

Table 2: Bread making quality scores based on SDS-sedimentation test assigned to single or pairs of HMW glutenin subunits

Score	Glu-A1	Glu-B1	Glu-D1
4	-	-	5+10
3	1	17+18	-
3	2*	7+8	-
3	-	13+16	-
2	-	7+9	2+12
2	-	-	3+12
1	Null	7	4+12
1	-	6+8	2 + 10
1	-	20	-

Results and discussion

The bread making quality of wheat is primarily influenced by its protein content and protein quality and is generally recognized to be very complex (Ivanov *et al*., 1998). The HMW glutenin subunit composition and Glu-1 quality score of each variety, according to the method described previously (Payne *et al*., 1987; Lukow *et al*., 1989), i.e. by summing the score previously assigned to each of three Glu-1 alleles individual or pairs of subunit (Table 2). The present results indicated that the subunit composition varied considerably among genotypes (Table 1). The results revealed that the HMW glutenin subunit 1 encoded at *Glu-A1* locus was observed in 8 genotypes, subunit 2* in six genotypes and null allele in 13 genotypes. Subunits 7+9 and 7+8 encoded by *Glu-B1* locus were present in 10 and 6 genotypes, respectively. Subunits 17+18 and 20 were observed each in five genotypes, whereas the subunit 7 was observed in genotype DI 716. Among Glu-D1 encoded subunits, only 5+10 and 2+12 were observed in the present study. Fifteen genotypes were having 2+12 subunit, while subunit 5+10 was present in remaining 12 genotypes.

Based on the different glutenin subunits composition, *Glu-1* score of each genotype were calculated in the present investigation and listed in table 3. Clear differences were noted in the

Glu-1 scores of different genotypes. The variety WH 423 had the highest *Glu-1* score. The five genotypes had Glu-1 score of 9 and the nine genotypes had Glu-1 score of 8. *Glu-1* score of 4 and 5 observed in 3 wheat genotypes each. The remaining six genotypes had *Glu-1* score with 6 or 7. In a series of investigations it was shown that the variety, WH 423 have Glu-1 quality score of 10 (highest) and have good quality followed by WH 533, WH 542, PBW 343, UP 2425 and HGPC which had Glu-1 quality score 9. Other genotypes have Glu-1 quality score ranging from 4 to 8.

Table. 3 HMW Glutenin subunit composition and Glu-1 quality score

Sr. No.	Genotype	Subunits	Total
1	WH 147	1 + 3 + 2	6
2	WH 157	1 + 2 + 2	5
3	WH 283	1 + 3 + 2	6
4	WH 291	1 + 3 + 2	6
5	WH 416	1 + 1 + 2	4
6	WH 423	3 + 3 + 4	10
7	WH 533	3 + 2 + 4	9
8	WH 542	3 + 2 + 4	9
9	WH 711	3 + 2 + 2	7
10	C 306	3 + 1 + 4	8
11	C 591	3 + 1 + 4	8
12	Sonak	1 + 2 + 2	5
13	HD 2687	1 + 2 + 2	5
14	PBW 343	3 + 2 + 4	9
15	PBW 373	1 + 2 + 4	7
16	Raj 3765	3 + 3 + 2	8
17	UP 2338	3 + 3 + 2	8
18	UP 2425	3 + 2 + 4	9
19	C306M10	3 + 3 + 2	8
20	DI 8	3 + 3 + 2	8
21	DI 9	3 + 3 + 2	8
22	DI 16	1 + 1 + 2	4
23	DI 20	1 + 1 + 2	4
24	DI 716	1 + 1 + 4	6
25	DI 717	1 + 3 + 4	8
26	DI 728	1 + 3 + 4	8
27	HGPC	3 + 2 + 4	9

In a series of investigation it was shown that subunit 5+10 from chromosome 1D, subunits 1 and 2* from 1A and subunit 7+8 from 1B associated with good quality (Ivanov *et al*., 1998, Bhagwat and Bhatia 1993). Zhang (2001) detected 13 allelic variations at Glu-D1 locus, in which subunits 1.5, 10 and 5, 12 that were important to quality breeding compared to subunit 5 10 were identified. In this study (Table 3), the subunits of chromosome 1A (1 and 2*), 1B (7+8 and 7+9) and for 1D (5+10) are associated with good bread making quality. The frequent occurrence of HMW glutenin subunits 7+8 and 7+9 encoded at the Glu-B1 locus has already been reported in several European collections (Santag-Strohm, 1996, Igrejas *et al*., 1999) and spring wheat cultivars and breeding lines (Tohver *et al*., 2001). Lukow *et al*., (1989) having studied HMW subunit composition of a great number of Canadian varieties obtained data for the high positive effect of 5+10 allele on the wheat quality. Their conclusion is that the best quality of a wheat variety composed of 1A subunits 1or 2*, 1B subunits 7+8 & 7+9 and chromosome 1D subunit 5+10 were invariably presented. Therefore, the bread making quality of wheat cultivars is determined by their 1D chromosome composition (5+10 subunit) and to a lesser degree of by chromosome 1A (1 and 2*). The combination of genotypes with HMW glutenin subunits 5+10 and 2+12 is used widely in Hungary. The combination of these two genotypes in a single population may be of particular interest in regions where gluten content changes substantially due to environmental conditions (Bedo *et al*., 1995). The verified correlations between breadmaking quality and specific HMW subunits of glutenin can be utilized by wheat breeders using SDS-PAGE of proteins as a screening test for the prediction of the bread making quality of wheat (Galova *et al*., 2002). Hence, it can be concluded that genotypes WH 423, WH 533, WH 542, PBW 343, UP 2425 and HGPC have highest Glu-1 quality scores hence, once again proved to be best for bread making quality. Also it is emphasized that Glu-1 quality score can serve as a useful selection criterion in selection of wheat genotype for bread making quality.

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